International Journal of Academic Multidisciplinary Research (IJAMR)
ISSN: 2643-9670
Vol. 4 Issue 7, July – 2020, Pages: 5-13

Adherence to Antiretroviral Therapy and Performamnce on the Neuropyschological Test Battery

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Abstract: *This study sought to assess the relationship between adherence to antiretroviral therapy (ART) and performance on the neuropsychological test battery. With regards NPS test, subjects who reported ≥ 95% adherence performed better than those who reported less than 95% adherence. There was no relationship between performance on the NPS domains and gender with regards adherence to antiretroviral therapy (ART) and also results indicated that adherence to antiretroviral therapy did not predict performance on the NPS domains with respect to education. There were no differences in NPS test performance between Adherents and Non-Adherents in terms of age. However, the study found that there were there was significant difference in adherence to antiretroviral therapy in terms with respect to levels of education. The GDS impairment found that more females were more impaired than the males. The present study also found that education and gender had no effect on performance on the NPS domain with respect to adherence or non-adherence to antiretroviral therapy.*

Keywords-Adherence, HIV-positive, Neuropsychological test battery, Regimen

1. INTRODUCTION

The human immunodeficiency virus (HIV) has continued to be a public health concern owing to its devastating effects upon mankind. While it is acknowledged as a global disease, the most affected is sub-Saharan Africa which represents 68 percent of the world's HIV infection. Although sub-Saharan Africa shoulders the heavy burden of the disease, there is also a gender imbalance in the disease distribution with a higher infection rate being in women, whereby for every 14 infected women there are 10 males infected (UNAIDS, 2011).

In the Zambian context, the prevalence of HIV cuts across all age ranges, gender and education but even in the Zambian scenario more women rather than men are affected by the disease. The HIV prevalence in females is considerably higher in comparison to that of men at younger ages and considerably lower at older ages. On the other hand, there is a higher prevalence of HIV among men and women with higher education than those with lower education (UNAIDS, 2009).
However, due to the introduction of antiretroviral therapy in 1996 globally, the mortality rate in HIV infected adults has significantly decreased (WHO, 2003).

Nevertheless, like any other chronic illness, adherence to drug therapy is critical if the disease is to be contained. Treatment interruptions and inconsistent drug intake leads to inadequate viral suppression response, which conversely result into viral resistance and clinical progression (Friedland and Williams, 1999). While universal access to treatment in Zambia has achieved coverage levels of between 70 and 80 percent following the introduction of free access to antiretroviral therapy, adherence to ART is rather a challenge (UNAIDS, 2011).

Problem of adherence has to do with neurocognitive dysfunction as patients often do not adhere to the treatment. Although there may be many reasons that individuals may not adhere to their medication, on significant risk factor for non-adherence is neurocognitive impairment. Several researchers have found that sound neuro-cognition supports adherence to antiretroviral therapy (Albert et al., 1999; Chesney, Morin, & Sherr, 2000; Hinkin et al., 2002).

Neuropsychological assessment has played essential role in the identification of patterned impairment in HIV infected persons. It has proved useful in the diagnosis of HIV-related cognitive disturbances and is used widely to quantify changes in cognitive processes associated with treatment. A battery of neuropsychological tests designed to cover the cognitive and behavioural domains affected by HIV-1 infection has been widely used to assess neurocognitive functioning in HIV-infected persons (Butters, et al 1990).

In this study the test battery used to measure the neurocognitive effect on adherence to ART is the Neurobehavioural Test Battery which has 14 tests split into 7 neuropsychological domains. These include the following:

a) Speed of Information Processing: Consists of Trail Making Test Part A, Colour Trail One, WAIS-III Digit Symbol, WAIS-III Symbol Search and Stroop Colour.
b) The Motor Dexterity Domain: Consists of the Grooved Pegboard Test, dominant and non-dominant hand.
c) The Executive Functioning Domain: Consists of the Colour Trails 2, Halstead Category Test, Wisconsin Card Sorting Test and Stroop Colour-Word.
d) **The Visual Episodic Domain:** Consists of the Brief Visual Memory Test –Revised Learning and delayed recall.
e) The Verbal Fluency Domain: Consists of the Controlled Word Association Test- FAS, Category Fluency Test (Animal and Actions) and the Stroop Word.
f) The Working Memory and Attention Domain: Consists of the Paced Auditory and Serial Addition Test and the Spatial Span
g) The Verbal Episodic Domain: Consists of the Hopkins Verbal Learning Test-Revised learning and delayed recall.

1.1 RELATED LITERATURE

Adherence to medication has been known to be problematic in almost all conditions even when the treatment schedule is simple to follow (American Psychological Association, 2010). There is no gold standard measure for adherence, although there is slight consistency to account for adherence or non-adherence (WHO, 2011). Literature has shown that, the optimum adherence threshold of 95% or more suggests that the viral load would be contained but, any adherence rates less than 70% are not optimal and rarely show improvement in viral markers (Frain, et al., 2009). While some means of reporting adherence may not be absolute, HIV-infected client self-report is the most often used process for its quick and inexpensive means of monitoring adherence, but also poses the challenge of reliability and accuracy.

The other factor which affects adherence to antiretroviral therapy is the complicated regimen to be followed, such as the need for daily administration, drug combinations, dietary restriction, and frequency of dosing or amount of liquids to be taken with the drug. Some ARV drugs particularly protease inhibitors require combinations. In others instances, swallowing many pills throughout the day is required which a number of people find hard to do. Consequently, the size of the pills can also be a crucial factor in the adherence process (WHO, 2003).

A number of studies have implicated cognitive impairment in many aspects of non-adherence to antiretroviral therapy. Although several researches have shown the relationship between cognitive impairment and non-adherence, few studies have assessed the relationship of cognitive abilities with the understanding of ART prescription (Albert, et al., 1999).

A study conducted in the US by Moore, et al (2012) to identify an abbreviated test battery for detection of HIV-associated neurocognitive impairment (NCI), found that in early managed HIV-infected cohort combinations of widely accepted neuropsychological tests with brief implementation time demonstrated good sensitivity and specificity compared to a time intensive neuropsychological test battery.

A study of adherence found that both neurocognitive impairment and the complexity of a medication regimen were predictive of lower adherence rates; cognitively impaired participants prescribed more complex regimens demonstrated the lowest rates of adherence. The cognitive impairments most closely associated with poor adherence were deficits in executive function, memory, and attention (Hinkin et al; 2002).
The influence of educational variables on test performance represents a well-established observation in psychological measurement (Anastasi, 1988; Cronbach, 1990). Studies have shown that there is a relationship between education and adherence to ART which consequently demonstrate good performance on the neuropsychological tests.

Most adherence studies have highlighted gender differences regarding compliance and non-compliance to ART, but few studies have examined gender differences and performance on neuropsychological tests. In a study to examine predictors of neuropsychological performance in HIV positive women conducted in the USA by Durvasula, et al (2001), a sample of 237 HIV positive and negative women were recruited. Using multiple regression analysis, testing the association between HIV status and neuropsychological performance and controlling for predictors such as age, psychological distress, education, drug and alcohol use, the results showed being HIV positive predicted poor performance on tests of psychomotor speed than being HIV negative.

Age, education, and gender are the most common indicators used to define normative standards against which neuropsychological performance is interpreted, but influences of other demographic factors have begun to be appreciated. In developing nations like Zambia, urban versus rural residence may differently affect numerous factors that could influence cognitive test performances, including quality of both formal and informal educational experiences. Therefore, demographic disparities such as urban/rural should be taken into consideration when trying to come up with a standard in neuropsychological norms

A study conducted by Hinkin, et al., (2003) involving HIV positive adults aged between 25 and 69 years on a self-administered antiretroviral therapy after all participants completed a comprehensive battery of neuropsychological test as well as a structured psychiatric interview, found that the mean adherence rate for the entire cohort was 80.7%, with older patients (≥ 50 years) demonstrating significantly better medication adherence than younger patients (87.5 versus 78.3%). Logistic regression analyses found that older patients were three times more likely to be classified as good adherers defined as (≥ 95% adherent). Among the older patients, those who were classified as poor adherers performed significantly worse on neuropsychological testing, particularly on measures of executive functioning and psychomotor speed.

Barclay et al (2007) conducted a theoretical framework study encompassing demographic characteristics, psychiatric functioning, health beliefs/attitudes, treatment self-efficacy, locus of control, and neurocognitive status in relationship to HAART adherence in an ethnically diverse sample of HIV+ individuals. The rate of poor adherence was twice as high among younger participants than older participants (68% and 33%, respectively). Results of binary logistic regression revealed that low self-efficacy and lack of perceived treatment utility predicted poor adherence among younger individuals

2 METHODOLOGY

2.1 Study Design

This study employed a cross-sectional design which involved administering the neuropsychological battery to assess different functioning of the brain and the nervous system such as memory, attention, motor and psychomotor. The participants also completed a series of questionnaires involving demography, psychiatric history, history of substance abuse, neurological condition as well as functioning in their daily lives. The participants' adherence to ART was measured using the AIDS Clinical Trials Group (ACTG) adherence questionnaire

2.2 Study Population

The study population comprised HIV positive Zambian adults from the age of 20 to 65, in urban clinics of Lusaka district.

2.3. Participants

In the current study a total of 263 participants were recruited of which 107 (40.7%) were males and 156 (59.3%) were females. The study sample comprised HIV positive Zambian adults, with an age range of 20 to 65 years, drawn from six urban clinics of Lusaka. The participants comprised males and females and their academic levels ranged from 5 to 20 years of schooling. Mean years of education was 10.02 with a standard deviation of 2.233. The ages of the subjects were classified into four categories; 20-35, 36-45, 46-55 and 56-65 ages. Education category was classified as follows 5-7, 8-9, 10-12 and 13-20 years of schooling. This variable represented primary, secondary and tertiary categories respectively.

2.4 Recruitment

The participants were recruited from six health centres in urban clinics of Lusaka district under the District Health Management Board (DHMB) this was after consent was sought from the University of Zambia Biomedical Research Ethics Committee and approval from Ministry of Health (MoH) through the Lusaka District Health Management Board for access to the different health centres under their supervision. The six chosen clinics of Chilenje, Chipata, Kabwata, Kalingalinga, Matero-Main and Matero-Referal had voluntary and counselling and testing (VCT) centres where HIV positive individual access ART. The individuals recruited were already confirmed HIV-positive and were on ART. The researcher worked together with medical personnel from the clinics, in recruitment and making appointments of the potential participants.

Tentatively, the researcher explained to the prospective participants about the purpose and nature of the study. Those who wished to take part in the study were given the information sheet to read. Those who agreed to participate were then given the informed consent which they signed. The potential participants were also informed that they could withdraw from the study at any point if they wished. They were also informed that for confidentiality purposes, participants' names were not going to be used; instead codes were to be applied.

2.5 Sampling Procedure

Purposive sampling procedure was used since the sample required were HIV positive. Individuals who failed to meet the screening criteria such as use of English language (as assessed by the *Zambia Achievement Test -ZAT),* as well as psychiatric and drug abuse screening using the Chinese Substance abuse scale and substance abuse questionnaire, neurological confounding factors and the depression using the Beck Depression inventory. Upon completion of the assessment using the international neurobehavioral test battery all the participants completed the AIDS Clinical Trail Test Group (ACTG) questionnaire which assess adherence to antiretroviral therapy (ART) in HIV positive individuals.

2.6 Instruments

The instruments that were used in data collection procedures are stated below:

a) Screening Effort – Under this domain, is the Hiscock Digit Memory Test. The test has been designed to clinically identify an individual thought to be malingering. The participant is asked to remember some numbers and then asked to identify the set that the participants had (Prigatano and Amin, 1993).

b) Beck Depression Inventory: The inventory is used to assess depression. The inventory consists of 21 items. Depression is a serious psychiatric illness. An individual with depression will not performance well on all tests that assess the seven domains. This is a 21-item self-report scale which has four options responses on each item that are of perceived severity within a period of two weeks. It takes about 10 minutes to administer the Beck Depression Inventory (BDI). Therefore, individuals who had high scores on this test were excluded from the study.

c) Substance use and Chinese Substance Use History: The questionnaires contain a list of drugs and alcohol and the participant is required to state which ones and how much they have used in the last three months. These questionnaires further require the participants to state details of the frequency of use and the quantities for each drug or alcohol stated to have been misused.

2.7 Neuropsychological assessment

The International neurobehavioral test battery (see appendix G) was used in this study. This test battery has been widely used in a number of neurobehavioural studies of HIV and AIDS (Heaton et al. 1995, Albert et al., 1999; Chesney, Morin, and Sherr, 2000; Hinkin et al., 2002, 2004). It has also been used in Zambia and the norms have already been established (Hestad, Menon, Shilalukey-Ngoma, et al., 2012). Therefore, results from the tests in the battery can be relied upon. This test battery assesses seven cognitive as outlined here below:

a) Speed of information processing: This domain comprises Digit Symbol and Symbol Search which tests processing speed under the WAIS-III. We also have Stroop Task, the colour card (C) which measures speed of information processing as well. The participant is asked to name colours as quickly as possible within 45 seconds while maintaining precision. The other one is the Trail Making Test (TMT) part A where a test taker connect numbers in order in short time and colours and numbers (Strauss et al 2006).

b) Attention/working memory: This includes the Paced Auditory Serial Test (PASAT) which measures attention and concentration, speed of information processing, mental tracking and calculation. It also assesses ability and speed of information processing and sustained and divided attention (Spreen and Strauss, 1998). We also have the Spatial Span adapted from Wechsler's Memory Scale – third edition) has 10 cubes in which the participant is required to follow a sequence of tapping the blocks both forwards and backwards.

c) Abstraction/Executive functioning: This domain consists of the Stroop Word Colour Test, Halstead Category Test and The Wisconsin Card Sorting Test. The Stroop Word- Colour task has names of colours printed in a contrasting ink colour. The Halstead Category Test measures one's ability to conceptualize qualities such as size, shape, number, position and colour. The Wisconsin Card Sorting-64 originally consisted of 60 cards with one to four symbols which are a triangle, a star, cross or circle in the following colours: red, green, yellow and blue. It was meant to measure "abstract behaviour and shift of set" (Lezak et al, 2004).

d) Verbal Fluency/ Language-Controlled Oral Word Association Test will be used to assess language. Its purpose is to evaluate unprompted production of words within a limited space of time (Straus, Sherman, Spreen, 2006). The participant is tasked to produce as many words as possible beginning with a letter in trail three within the time frame of 60 seconds for each trial. Further, the participant should not produce nouns or names of places. Under the Category Test (Animal and Actions) the participant is asked to mention as many animals as they can think of within 45 minutes. Simultaneously, the test taker is allowed to itemize as many things that people do.

e) Motor Dexterity– This domain will be measured using the Grooved Pegboard Test (Dominant & Non-Dominant Hand trials). This assesses eye-hand coordination and motor speed (Strauss et al., 2006). Starting with the dominant hand first, the participant must insert the pegs in the holes as fast possible in a sequence without skipping any hole. The same procedure should be repeated with the non-dominant hand.

i) Verbal Episodic Memory-This domain include the Hopkins Verbal Learning Test-Revised (HVRT-R). It measures learning ability and delayed recall and verbal information across three trials (Strauss, et al 2006). Also assess an individual's capacity to retain, reproduce and recognize information after delay. HVRT-R consists of 12 nouns with four words drawn from three semantic categories.

ii) Visual Episodic Domain–The domain measured by Brief Visio-spatial Memory Test-Revised (BVMT-R) is visual memory learning and memory using a multiple-list learning model. It measures immediate and delayed recall (Strauss, et al 2006). The test taker is presented with a cards containing six simple geometric figures for 10 seconds and after that is asked to reproduce as many of the designs as possible on a piece of paper in the same location as they appeared on the display presented to him before.

2.8 Measuring Antiretroviral therapy

Assessing medication adherence is already a difficulty undertaking considering that there is no single questionnaire that is considered accurate. In this study adherence to antiretroviral therapy (ART) was measured by an instrument called AIDS-Clinical Trial Group (ACTG) questionnaire. The AIDS Clinical Trial Group has also been used in studies conducted in Zambia (Jones et al 2009; Chesney et al. 2000).

2.9 DATA ANALYSIS

Data analyses were conducted with the help of Statistical Package for Social Sciences (SPSS) version 20.

- Descriptive statistics were used on demographic variables so as to come up with means and standard deviations.
- We performed descriptive analyses and comparisons to examine the demographic characteristics of subjects.
- Chi-Squared test was also used to determine differences in adherent to ART between males and females across demographics.
- To determine differences in neuropsychological performance on adherence to ART, age, education and gender, analyses of variance (ANOVA) was performed.
- Independent t-tests and analysis of variance were used for comparisons of the variables.
- To determine differences in NPS performance on ART across education gender and age multivariate analysis of variance were performed.
- ANOVA was also used to determine whether age predict adherence to ART among HIV-positive individuals.

3 OBJECTIVES OF THE STUDY

1. To establish whether adherence to ART is related to performance on the NPS test battery.
2. To investigate whether adherence to ART is related to performance on the NPS test based on gender.
3. To find out whether adherence to ART is a predictor of performance on the NPS test based on education.
4. To determine whether adherence to ART is a predictor of performance on the NPS test based on age.

3.1 Hypotheses

a) Non-Adherent will perform poorly on neuropsychological test than Adherents.
b) Adherence to ART is related to performance on the NPS test based on gender.
c) Differences in adherence to ART will predict performance on the NPS test based on education.
d) Age will predict adherence to antiretroviral therapy among HIV-positive individuals.

4. RESULTS

Table 4.1 Distribution of the whole sample (n=263)

Demographics	Frequency	Percentage (%)
Gender		
male	107	40.7
female	156	59.3
Age		
20-35 years	76	28.9
36-45 years	110	41.8
46-55 years	59	22.4
56-65 years	18	6.8
Education		
5-7 years of schooling	41	15.6
8-9 years of schooling	125	47.5
10-12 years of schooling	79	30.0
13-20 years of schooling	18	6.8

Table 4.2 Age and education of Adherent and Non-adherent participants

Demographics	n=83 ≥ 95% Adherent Mean (SD)	n=158 < 95% Non-Adherent Mean(SD)	p-value
Age	40.66(9.48)	40.86 (8.85)	.982
Education	9.53(1.89)	10.13 (2.35)	.016*

*p < .05

There was no statistical significant difference between Adherents and Non- Adherents in terms of mean age. However, there was statistical significance difference in terms of mean education in that Adherents had more years of education than Non-Adherents.

Table 4.3 Adherence levels at ≥ 95% cut-off based on gender

Variable	n (%)	df	χ^2	p=value
Male	**21(19.6%)**	**2**	**12.368**	**.002***
Female	**62(39.7%)**			

*p < .05

The Chi-square test showed that there were different levels adherence in terms of gender ($X^2 = 12.37$, df = 2, p = .002). The number of females 62(39.7%) were more adherent

compared to males 21(19.6%). There was association between gender and adherence.

Table 4.4 GDS impairment by gender (=263)

GDS	Males (%)	Females (%)	df	χ^2	p-value
Normal	72(67.3%)	102(66.4%)	1	.103	.748
impaired	35(32.7%)	54(34.6%)			

The GDS cut-off point indicated that impairment across gender was non-significant (X^2 = .103, df = 1, p = .748). The results showed that 72(67.3%) of the males and 102(66.4%) of the females were normal, while 35(32.7%) of the males and 54(34.6%) of females were impaired.

Table 4.5 GDS impairments by education

Variable	Impaired	Normal
Tertiary 13-20	5(27.8%)	13(72.2%)
Grade 10-12	37(29.6%)	88(70.4%)
Grade 8-9	32(40.5%)	47(59.5%)
Grade 5-7	15(36.6%)	26(63.4%)

df	χ^2	p-value
3	3.005	.391

*p < .05

The Chi-square test was run to compare the GDS across education levels. There were no significant differences GDS across the education levels. (X^2 = 3.005, df = 3, p = .391).

Table 4.6 GDS impairment by age

variable	Impaired	Normal	df	χ^2	P=Value
56-65 years	**7(38.9%)**	**11(61.1%)**	**3**	**9.857**	**.020***
45-55 years	**15(25.4%)**	**44(74.6%)**			
36-45 years	**31(27.9%)**	**80(72.1%)**			
20-35 years	**36(46.7%)**	**40(53.3%)**			

*p < .05

There was significant differences GDS across the ages cohorts. (χ^2 = 9.86, df = 3, p = .020). GDS impairment by age shows that 7 out of 18 of the participants aged 56-65 were impaired while 15 out of 59 of the participants aged 45-55 were impaired. 31 out of 111 in the age group of 36-45 were impaired and 36 out of 76 participants in the age group 20-35 were impaired.

Table 4.7 Gender and neurocognitive impairment

Mean (SD)	t	sig.	eta squared	95% CI of difference Lower Upper
Males .46(.44)	.202	.840	.0001	-.12 .10
Females .47(.45)				

An independent sample t-test was conducted to compare Global Deficit Scores (GDS) between males and females. There was no significant difference in scores for males (M= .46, SD=.44) and females (M=.47, SD=45); t (261) = -.206, p=.840 (two-tailed). The magnitude of the differences in the means (Mean= -.011, 95% CI: -.12 to .10) eta Squared (.0001) was very small.

Table 4.8 adherence scores based on education levels

Years of schooling	≥ 95% adherent	< 95% Non-adherent	df	χ^2	p
5-7	**13(31.7%)**	**26(63.4%)**	**6**	**18.09**	**.006***
8-9	**37(46.8%**	**40(50.6%)**			
10-12	**29(23.2%)**	**81(64.8%)**			
13-20	**4(22.2%)**	**11(61.1%)**			

*p < .05

To find out adherence across education levels, Chi-square was run. The results of adherence across education levels were significant. (X^2 = 18.09, df = 6, p = .006).

Table 4.9 adherence score based on age

Age	≥ 95% Adherent	< 95% Non-Adherent	df	χ^2	p
20-35	**23(30.3%)**	**49(64.5%)**	**6**	**6.728**	**.347**
36-45	**37(33.6%)**	**59(53.6%)**			
46-55	**17(28.8%)**	**38(64.4%)**			
56-65	**6(33.3%)**	**12(66.7%)**			

To determine adherence scores across the age the results of adherence score with respect to age were non-significant. (X^2 = 6.728, df = 6, p =. 347).

5. DISCUSSION

The objective of this study was to assess the relationship between adherence to antiretroviral therapy (ART) and performance on the neuropsychological test battery. This study showed that there was no significant difference between the Adherents in terms of age. As regards adherence based on gender, there was no significant difference in adherence scores between males and females.

Global deficit impairment across adherence score indicated that the 174 (66.2%) of the sample were normal while 89(33.8%) were impaired in terms of GDS impaired versus normal. In his study, Letendere et al (2011) suggest that high incidence of HAND in ART relates to the difficulty posed by the blood brain barrier (BBB) for the passage of drugs into the CNS.

The GDS results indicated that female 53(34.0%) were more impaired than the males 35(32.7%). Whereas in the

unimpaired range, the results showed that more males 72(67.3%) were in unimpaired compared to the females were 103 (66.0%) were unimpaired. However, there were no differences in the GDS with respect to gender.

The GDS impairment by education levels indicate that participants in the education levels Grade 10-12 were the most impaired 37(29.6%) and also had the highest number in the unimpaired range 88 (70.4%). The least impaired participants with respect to education were in the tertiary category at 5(27.8%) with the unimpaired participants in the tertiary education being 13(72.2%).

The GDS impairment by age in this study indicates that participants in the age of 20-35 years were the most impaired 35 (46.7%) out of 70 participants while the GDS impairment of the age 56-65 years were the least impaired 7(38.9%) out of 18 participants. Our findings are not congruent to a more recent study by Dennis et al (2011) who compared demographically and infections-status matched with younger and older individuals on measures of neuropsychological functioning and found that the older group of HIV-infected individuals had a higher rate of impairment across most ability domains.

The impairment across the neurocognitive domains showed that the ability to learn were the most affected domain while the motor were the least affected domain. In the ability to learn in 71.1% were in normal and 28.9% were impaired. On the other hand, the motor domain was the least impaired and 88.2% were normal and 11.9% were impaired. Most of the affected participants were in the mild-impairment, while there were no participants represented under the severe level.

A t-test run to compared neuropsychological performance between the subjects who reported ≥ 95% adherence levels and those who reported less than 95% adherence levels**.** The results of the current study showed that Adherents performed better on the GDS, executive function, recall and speed of information processing compared to individual on Non-Adherents on antiretroviral therapy. There were no differences in neuropsychological test performance between Adherents and Non-Adherents on the verbal fluency, working memory, learn and motor.

The univariate analysis found that education and gender had effect on adherence scores. The results of this study are consistent with previous findings (Unge et al. 2010) reported that lower education levels accounted for poor ART-adherence which conversely affected individual performance on neuropsychological tests.

The Results also showed that individuals whose adherence score was more than 95%, performed better in the test domain of the Executive function, Recall, Speed of Information Processing and the Global than HIV-positive individuals whose adherence score was less than 95%. According to literature, deficits in the executive functions are also strongly associated with impairment in everyday functioning (Heaton et al. 2004).

It was also observed that there were no significant differences in performance on neuropsychological tests between males and females with respect adherence to ART. The finding of our study were contrary to studies conducted by Holguin et al (2011), that gender significantly influence performance on the neuropsychological test with females performing poorly compared to males.

The findings of the current study seem to show that adherence to antiretroviral therapy may not necessarily predict performance on the neuropsychological test based on the education levels. However, other studies have indicated that poor overall neuropsychological functioning as well as deficits in individual domains of functioning, including psychomotor speed, memory, and executive functioning is associated with poor adherence (Hinkin, et al 2002).

6. CONCLUSION

The objective of the study was to assess the relationship between adherence to antiretroviral therapy (ART) and performance on the neuropsychological test battery. This study has shown relationship between adherence to antiretroviral and performance on the neuropsychological test battery across age, gender and education. It has demonstrated that there was no difference in between Adherents and Non-Adherents in terms of age. However, the study found that there was significant difference in adherence to antiretroviral therapy in terms with respect to levels of education.

The Global Deficit Score (GDS) impairment found that more females were impaired than the males. Conversely, the study showed that more males were found in unimpaired range compared to the females. Furthermore, impairment by education levels, our study found that least impaired participants were those in the tertiary category. One interesting thing regarding GDS impairment by age was that participants in the age cohort of 20-35 were the most impaired while the least impaired age-group was found in the 56-65 years old.

This study also found that education and gender had effect on adherence to antiretroviral score. In addition, our study also found that adherence to antiretroviral therapy is related to performance on the executive function, recall and speed of information processing.

With regards to our first hypothesis, HIV-positive individuals whose adherence score were more than 95% performed better on the executive function, recall, speed of

information processing and the global than HIV-positive individuals whose adherence score was less than 95%. Contrary to our second and third hypothesis, there was no relationship between adherence to antiretroviral and performance on the NPS test based on gender and education respectively. Finally, the findings of our study did support our fourth hypothesis, in that age did not predict adherence to antiretroviral therapy among participants with HIV-positive.

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